

# PATENT SPECIFICATION



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## COMPLETE SPECIFICATION.

### Improvements in or relating to Variable Speed Gears.

We, WOLF GINSCHOF BENJAMINOWITSCHE, a Lithuanian citizen, of 49A, Auguststrasse, Berlin, WOLF SNOZLS, BENJAMINOWITSCHE, a Lithuanian citizen, of 9A, Marburgerstrasse, Berlin, and HILDELS HILLMANN, a Lithuanian citizen, of 12, Siegfriedstrasse, Nurnberg, all in Germany, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The present invention relates to sun and planet wheel gearing for concentric shafts, e.g. for operating the Cardan shaft of a motor vehicle from the concentric driving shaft and also at different speeds with the possibility of reversal. In sun and planet gearings of this type it is already known to transmit the corresponding speed to the shaft which is to be driven by applying a brake to a portion of the gearing. It is naturally also known in gearings of this type to transmit the speed of the driving shaft to the shaft to be driven by a suitable clutch in order to attain the maximum speed.

The object of the present invention is to facilitate the construction of a gearing of this type, which is principally intended for motor vehicles, as much as possible. Its object is also to enable the application of the brake to the corresponding part of the gearing and likewise also the transmission of the speed directly from the driving shaft to the shaft to be driven to be effected from a single point, so as to enable the desired speed to be obtained or the shaft which is to be driven to be reversed as may be desired.

The essential feature of the invention is that a pressure disc which is mounted on the shaft to be driven exerts a pressure against the outer rings of teeth of the sun and planet wheel gearing

between which plates are provided, so that all the rings of teeth are pressed laterally against each other and can therefore be subjected to braking action as soon as the particular pressure disc is moved. By this operation of the pressure disc to all the rings of teeth the transmitting planet wheels and the gear wheels mounted on the shaft which is to be driven, but which act directly on it, are coupled directly, so that therefore direct transmission from the driving shaft to the shaft which is to be driven is secured.

Further details of the invention will be found in the following description.

A constructional example of the invention is illustrated in the drawing in which:—

Figure 1 is a longitudinal section through the entire gearing with an elevation of the controlling or operating device.

Figure 2 is a section through the shaft which is to be driven with the discs for positioning the planet wheels.

Figure 3 shows a portion of the controlling or operating device in plan.

Figures 4 and 5 show in detail modifications of the means for applying a brake to the several gears.

Figure 6 is a detail of the pressure disc. 1 is the driving shaft, which is carried at its free end in a boring in the shaft 2 which is to be driven. The sun and planet wheel gearing is housed in a closed casing 3. The gearing itself is of the usual well known construction, that is to say, on the driving shaft 1 are keyed fast a number of gear wheels of different sizes, which drive rings of teeth by planet wheels in such a way that when these rings of teeth are subjected to a braking action individually, the corresponding speed is transmitted to the shaft which is to be driven. Thus for example there is mounted first on the driving shaft

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a comparatively small gear wheel 4, which drives an intermediate wheel 5, the shaft 6 of which rotates freely in discs 7, 8 and 9. On the same shaft 6 is mounted a second gear wheel 10 which is rigidly connected to the gear wheel 5 by the shaft 6, and on the periphery of the discs 7, 8 and 9 of the shaft 2 which is to be driven are mounted freely rotating rings of teeth 11 and 12 toothed internally and which are provided with disc 13 and 14 respectively which only move axially and always rotate conjointly with the rings of teeth. The intermediate wheel 5 gears into the ring of teeth 11. The gear wheel 10 on the shaft 6 gears into the ring of teeth 12. As however both planet wheels are of different diameters, the ring of teeth 12 will be rotated more slowly than the ring of teeth 11. As long as the rings of teeth 11 and 12 can be rotated on the peripheries of the discs 7, 8 and 9 no transmission to the shaft which is to be driven takes place. If on the contrary one of the rings of teeth 11 or 12 be subjected to a braking action, the speed of rotation corresponding to the ratio of transmission between the rings of teeth 4, 5, 11 and 4, 10, 12 respectively will be transmitted to the shaft which is to be driven. In the example shown the gearing for the ring of teeth 12 is the one for lowest speed, that for the ring of teeth 11 on the other hand is the one for the next higher speed. In a similar manner there is mounted on the driving shaft 1 another gear wheel 15, which is larger than the gear wheel 4 and which gears by means of an intermediate wheel 16 into an internally toothed ring of teeth 17 which is likewise provided with an axially movable disc 18. Because a large gear wheel 15 is used here for driving purposes, the speed of the ring of teeth 17 is still greater than for the ring of teeth 11, so that therefore in this way three speeds can be obtained. The rings of teeth 11, 12 and 17 may conveniently run not directly on the peripheries of the discs 7, 8, 9 and 19 but may run on rollers or balls 20 so as to prevent loss by friction as much as possible.

In order also to permit of reversal the gear wheel 10 not only gears into the ring of teeth 12, but also into a gear wheel 21 mounted loosely on the shaft to be driven 2 and forming one piece with a disc 22. The rotation of the ring of teeth 21, which, as has already been stated, is driven by the gear wheel 10, is naturally the reverse of that of the internally toothed ring of teeth 12. If therefore the disc 22 be subjected to braking action rotation in the opposite direction that is

to say reversal will be transmitted to the shaft 2 to be driven owing to the fact that the gear wheel 10 now travels over the gear wheel 21 in the opposite direction.

The present invention relates in comparison therewith to a new construction for transmitting the full speed from the driving to the driven shaft and this apparatus is constructed as follows:—

On the tubular outer end of the driven shaft 2 is mounted a disc 23, which will be hereinafter referred to as the pressure disc and is acted upon by a spring, which bears on the one hand against the end of a boring in the pressure disc 23 and on the other hand against a sleeve 25 movable axially in the same disc 23. If therefore the sleeve 25 be moved in an axial direction (to the right in Figure 1) pressure will be exerted through the medium of the spring 24 on the pressure disc 23 and the plates and the rings of teeth will be pressed against each other. This pressing of the clutch plates against the rings of teeth 17 and 11 takes place therefore by the pressure disc 23 being moved towards the right in Figure 1, so that its periphery is brought into direct contact with the first plate 26, and presses this latter sideways, the pressure of the plates which are inserted with a slight amount of play being transmitted to the next plate 26<sup>1</sup> and the next ring of teeth 11. This ring of teeth presses the plate 26<sup>1</sup> against the lateral annular projection 7<sup>1</sup> which is fixed to the disc 7. By this sideways movement of the pressure disc 23 towards the right consequently causes two rings of teeth with the plates between them to be pressed together and consequently the whole gearing with the gear wheels 4 and 15 respectively of the driven shaft to be coupled fast together, so that the gear wheels only act as clutch members and the planet wheels which now no longer rotate on their axes carry the driven shaft with them at their own speed. It is naturally clear that when the pressure disc 23 in Figure 1 is moved towards the left and the pressure therefore ceases, that the transmission likewise ceases.

It is therefore advisable to further develop in a certain manner the means for producing this direct driving. Firstly to enable the axially adjustable pressure disc 23 which is mounted loosely on the shaft to be driven to participate in the rotation thereof, the disc 19 has screwed into it two or more screw bolts 27 which pass through the pressure disc 23 parallel to the driven shaft, and thereby compel this disc to take part in the rotation of the Cardan shaft. On the ends of

the screw bolts 37 are mounted on pivots 28 bell crank levers of which one arm 29 bears against a collar 30 on the pressure disc 23 while the second arm 31 is prolonged outwardly and rests by its end on the smooth periphery of a profiled cam 32. Adjoining this smooth periphery there is provided in the cam 32 an inclined groove shown in the drawing.

When the cam begins to rotate to the right in order to produce the direct driving of the driven shaft 2 no movement of this pressure disc will take place in the first phase of this movement notwithstanding the fact that the spring 24 acts upon the pressure disc 23 because on the one hand the cam 31 slides onwards on the smooth periphery of the arm 32 and on the other hand the arm 29 bears against the inner wall of the pressure disc 23, and therefore any movement of this disc is impossible. As soon however as during the further movement to the right of the cam 32 the arm 31 moves on in the inclined groove in the cam 32 the two arms 29, 31 which oscillate conjointly around the bolts 28 are caused to move in such a way that the arm 29 moves away from the inner wall of the pressure disc 23 and now therefore permits of the latter moving. As in the meantime however the spring 24 has become stressed in a comparatively high degree the pressure disc 23 will now be moved with comparatively great force sideways towards the right and acts in a corresponding measure on the plate disc so that the corresponding rings of teeth are intensively pressed.

Although the clutch plates 26 above described are in the position to apply a braking force to the rings of teeth of the different planet wheels, this can only be effected in conjunction with the pressure disc 23 or by it and also only by all the rings of teeth having the braking force applied to them conjointly. In order to enable the braking force to be applied to the different rings of teeth of the sun and planet wheel gearing independently of each other, it is necessary therefore to provide means for doing so fully described hereafter. As has already been stated above each of the rings of teeth 11, 12, 17 is provided with a separate disc like annular projection 13, 14 or 16. Each of these annular projections lies on the one hand between one of the fixed rings 34, 35 and 36 which are attached by screw bolts 37 for example or in any other manner to the casing 8 and one of the movable rings 38, 39 and 40, which are movable parallel to the longitudinal axis of the gearing.

If for example the ring 38 in Figure 1

be moved towards the right it presses against one edge of the disc 22 and at the same time consequently presses the whole disc against the fixed ring 34. The disc 22, which is connected to the reversing gear, has therefore a brake applied to it with the result that reverse motion is transmitted through the gearing to the driven shaft 2. If on the other hand the movable ring 38 in Figure 1 be moved towards the left it presses the annular disc fixed to the ring of teeth 12 against the fixed ring 35 and therefore applies a brake to the ring of teeth 12 with the result that now the lowest forward gear is transmitted to the driven shaft. In a similar manner the movement of the movable ring 39 has the same effect as when moved to the right in Figure 1 the annular disc 12 of the ring of teeth 11 has a braking force applied to it it being pressed against the fixed ring 35, while when movement towards the left takes place the ring of teeth 11 for the third forward speed has a braking force applied to it by the annular disc 13 being pressed against the fixed ring 36. The movable ring 40 finally is employed for the purpose of pressing the pressure disc 23 away from the clutch plates 26 when movement toward the left takes place.

The axial movements of the above mentioned movable rings are produced by tension rods or tension tubes and according to cams which are arranged on a common operating shaft which can be mounted as a tube on the steering shaft.

For example is the steering shaft of a motor car which can be rotated by the hand wheel 42 by the driver of the vehicle. On this steering shaft is mounted concentrically an operating tube for the rotation of which a hand wheel 44 is likewise provided. The rotation of this hand wheel may conveniently take place according to notches and also according to visible signs or marks by which in particular the speed corresponding to a particular position can be ascertained. Cams 49, 54 are provided on this operating tube for the different movable rings 38, 39 respectively. Each of these cams consists of two parts. As shown, for instance, in section in Figure 1, the cam 54 consists of an outer sleeve 45, which is acted on by a spring 46 and an inner sleeve 47 which is acted on by a spring 48 which latter acts in opposition to the action of the spring 46 on the corresponding sleeve in such a way that the two parts of the cam are permanently pressed together elastically. In a similar

manner the other cams are constructed also. In the cam 49 slides the pin of a two-armed lever 51 which oscillates about the shaft 50 and the lower arm of which (52) is connected to the ends of two tension rods 53 which are connected at their other ends to the movable ring 38. By means of the cam 49 therefore this ring in Figure 1 can be moved both to the right and to the left. The cam 54 acts on a similar lever 56 oscillating on the shaft 55 and having its lower end connected by the tubes 57 to the movable ring 39. The tubes 57 slide on the rods 53.

The movement of the movable ring 40 takes place on the other hand by tension rods 58 which can be acted on by a pedal lever 60 oscillating on the bolt 59. This pedal is acted on on the one hand by a spring 61 and on the other hand is connected by the tension rod 62 to a bell crank lever 63 which is connected by a pin and slot connection to the tension rods 58. If therefore the pedal lever 60 be depressed and brought into the position shown in Figure 1 the ring 40 will first be moved by the parts described and consequently the pressure disc will be disconnected from the clutch plates 26. This pedal lever 60 operates the bell crank lever 63 and is connected by tension rods 64 to the back wheel brake of a motor vehicle so that when the pedal lever is depressed not only is the pressure disc 28 moved back and a braking force applied to it at the same time but the wheel brakes are also applied and the motor vehicle consequently checked in its progress.

For this purpose it is also necessary of course to prevent any operation of any of the sun and planet gears. For this purpose the levers 51 and 56 by which the tension rods 53 and 57 are moved, are prolonged outwards beyond the cams 49 and 54 and provided on their free ends with rollers 65 and 66. The pedal lever 60 is also provided in the vicinity of the levers 51 and 56 with a two-armed lever 67 which has on its ends finger like projections or claws 68 and 69 which in their turn have bevelled off surfaces on their ends (70). The recesses 71 formed by the claws 68 and 69 are adapted to receive the rollers 65 and 66 which are carried on the ends of the levers 51 and 56. If therefore a braking force has been applied to one of the sun and planet gears by one of the corresponding movable rings 38 and 39, so as to transmit the corresponding speed to the driven shaft, the depression of the pedal lever 60 will cause the two-armed lever 67 to be swung around

whereby the lever 51 or 56 which is forced out of its normal position will first strike against the corresponding inclined face 70 and be moved aside by it until it attains its neutral position by dropping into one of the recesses 71, in which position the corresponding ring 38 or 39 is also thrown out of operation that is to say all action on the corresponding sun and planet gear is rendered impossible.

It follows from what has been said above therefore that on the depression of the pedal lever 60 all the parts of the gearing are returned to the neutral position, that is to say, that everything is thrown out of operation, provided that previously any speed was transmitted to the driven shaft, and everything is disconnected, while at the same time the brake is applied to the back wheels of the vehicle by means of the tension rods 64 so that not only is the motor cut out but the two brakes, the carian and the hub brakes operated also.

The action of the pedal lever 60 may however be produced quite independently by the simple rotation of the adjusting wheel. For this purpose there is mounted on the operating tube a cam 72 which is provided with a tappet 73 which lies in the path of the movement of the pedal lever 60 in such a way that when the adjusting wheel is adjusted in a certain way it acts on this pedal lever and depresses it, whereby the effects mentioned are produced.

In a similar manner to that adopted for the movable rings for the sun and planet gearing the cam 32 is also adjusted by a lever 76 oscillating about the bolt 74 by means of a cam 75.

The elastic construction of the cam 49, 54 is mainly used for the purpose of pressing the parts operated thereby, i.e. the movable rings elastically and yieldingly against the annular discs of the outer rings of teeth and against the fixed rings. The same purpose can however be attained in other ways e.g. by the means shown in Figures 4 and 6. According to Figure 4 for example the fixed ring 85 is constructed at its upper periphery of roof shape in cross section, and the ring 18 feathered upon the ring of teeth 11 is also correspondingly shaped so that when it is pressed against the fixed ring 85 by the movable ring 39, which has likewise a bevelled off face on the corresponding edge, its bevelled edge can also give to a certain extent. This ability to give or yield can be still further increased by radial cuts in the periphery of the ring 18.

The construction of these elastic parts

may also be carried out in the manner shown in Figure 5 wherein the fixed ring 85 consists of two parts 85<sup>1</sup> and 85<sup>2</sup>, between which lie springs 77, so that the parts 85<sup>1</sup> and 85<sup>2</sup> of the ring can be forced apart to a certain extent according to the positions of the lugs 78 fixed to the wall of the casing. The rest of the construction is the same as that shown in Figure 4 but the interposed springs 77 show that a greater amount of elastic pressure can be obtained.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A sun and planet gearing for concentric shafts, in which one or other speed is transmitted to the shaft to be driven by applying a braking force to one or other of the said gearing, characterised by the fact that plates (26) which are mounted alongside the outer rings of teeth (11, 12, 17) of the sun and planet wheel gearing and also mounted loosely are pressed against the outer rings of teeth of the sun and planet wheel gearing by a pressure disc (23) mounted on the shaft to be driven (2) and by this means all the rings of teeth pressed against each other when the pressure disc in question (23) is axially moved for the purpose of simultaneously applying a clutching force to the different sun and planet wheel gearings and transmitting through the medium of the pressure disc (23) the speed of the driving shaft (1) directly as the maximum speed to the driven shaft and therefore producing a direct connection.

2. A sun and planet gearing according to Claim 1 characterised by the fact that in one of the parts of the sun and planet gearing which is connected to the driven shaft there are mounted pins (27) which pass through the pressure disc (23) mounted on the end of the gearing and are there provided with bell crank levers (29, 31) of which one arm (31) rests on the edge of a profiled cam (32) and the other arm (29) bears against the inner wall (30) of the pressure disc (23) and prevents any movement of the pressure disc (23) controlled by spring pressure and acted on by the axial movement of the cam (32) until the other arm (31) slips off the smooth periphery of the cam (32) and enters a depression (32) therein which permits the bell crank lever (29, 31) to swing round and now causes the pressure disc (23) to be pressed under the action of its spring (24) against the clutch plate (26) acting on the rings of

teeth (11, 12, 17) of the sun and planet wheel gearings.

3. A sun and planet gearing according to Claim 1, characterised by the fact that the several rings of teeth (11, 12, 17) of the sun and planet gearings are provided with brake discs (13, 14, 18) which lie between and alongside fixed rings (34, 35, 36) in the casing (3), with which they can be brought into contact by axially adjustable rings (38, 39, 43), so as to apply a braking force, as soon as the movable rings are moved through tension rods (or tension tubes) (53, 57, 58) and through levers by one of the various cams (49, 76) mounted on a sleeve (43) on the steering shaft (41).

4. A sun and planet gearing according to Claim 1 and 3 characterised by the fact that the cams (49, 54) of the speed controlling tube (43) are controlled by springs in such a way that a yielding action is produced by the tension rods on the axially movable rings for producing a braking action on one or other of the sun and planet gearings.

5. A sun and planet gearing according to Claims 1, 3 and 4, characterised by the fact that a single brake pedal is provided near the driver's seat which on the one hand moves through the medium of a system of levers and tension rods an axially movable ring (40) so as to move back the pressure disc (23) from the rings of teeth of the sun and planet gearings and thereby simultaneously apply a braking force to the driven shaft and also to apply through tension rods (64) a braking action to the back wheels of the motor vehicle and finally by means of a cam lever (68, 69) which when the brake pedal is operated, is rotated, to so set back the tension levers which act on the movable rings (38, 39) for applying the brakes to the rings of teeth of the various sun and planet gearings, that the application of the brake in the case of the various sun and planet gearings and consequently any simultaneous transmission of power to the shaft to be driven ceases and the brakes applied to the motor vehicle at the same time.

6. A sun and planet gearing according to Claims 1 and 5, characterised by the fact that there is mounted on the speed controlling tube (43) a disc with lateral cams (73) which in a certain position automatically depresses the brake pedal (60) so that all the effects brought about by the brake pedal can be brought about solely by these cams without operation by means of the foot.

7. A modification of the sun and planet gearing according to Claims 1 and 3

characterised by the fact that instead of the rings (84, 85, 86) mounted fast in the casing (8) either spring rings (see Figure 5) are employed which are constructed to move elastically in an axial direction or that the axially movable brake rings (38, 39) and the brake discs (13, 18) of the sun and planet gearing are made elastic at their edges (see Figure 4) and not only intensify the action of the brake on the different gears but are also made elastic to enable simple cams without spring action (as are the

cams 49, 54) to be used on the speed controlling tube if necessary. 1b

8. The variable speed gear substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 30th day of September, 1924.

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Fig. 1.

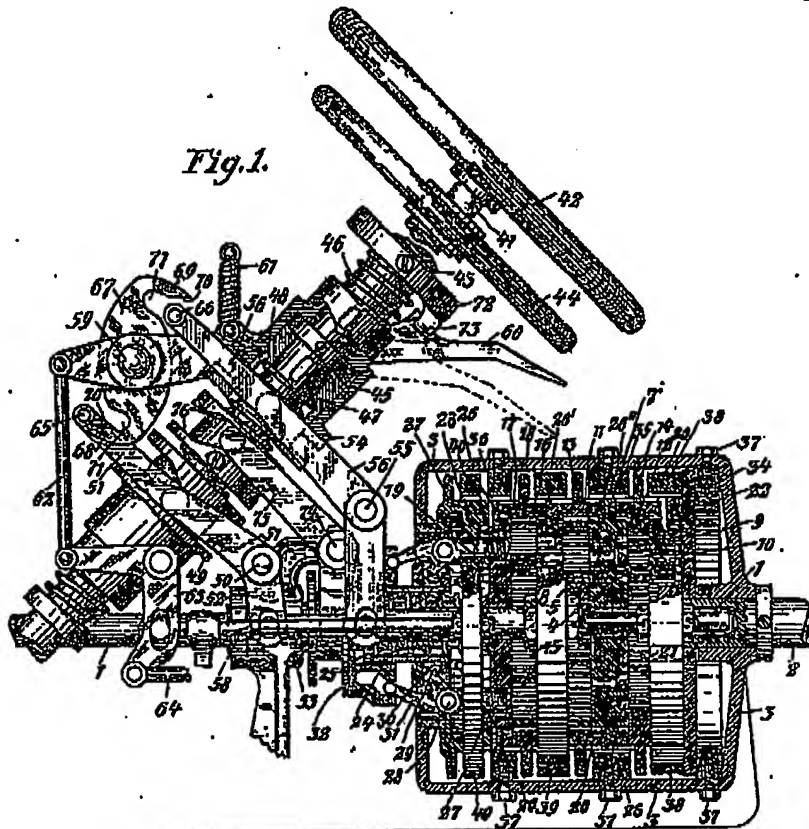
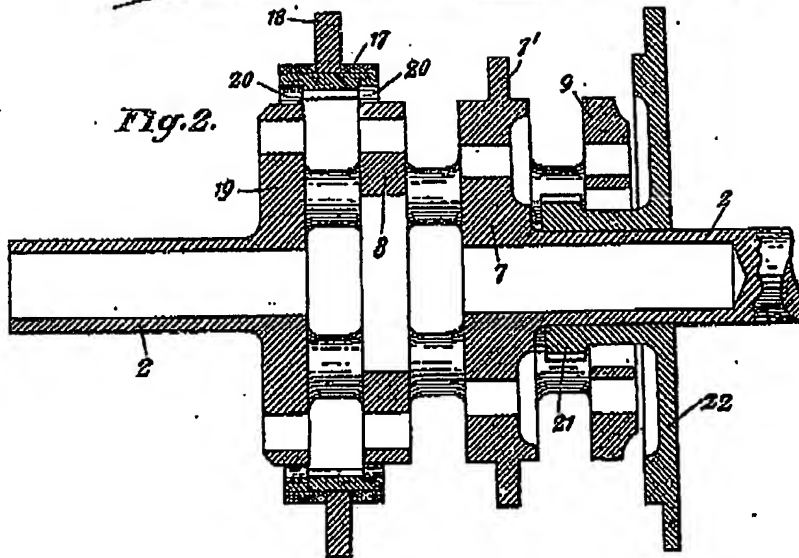


Fig. 2.



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Fig. 3.

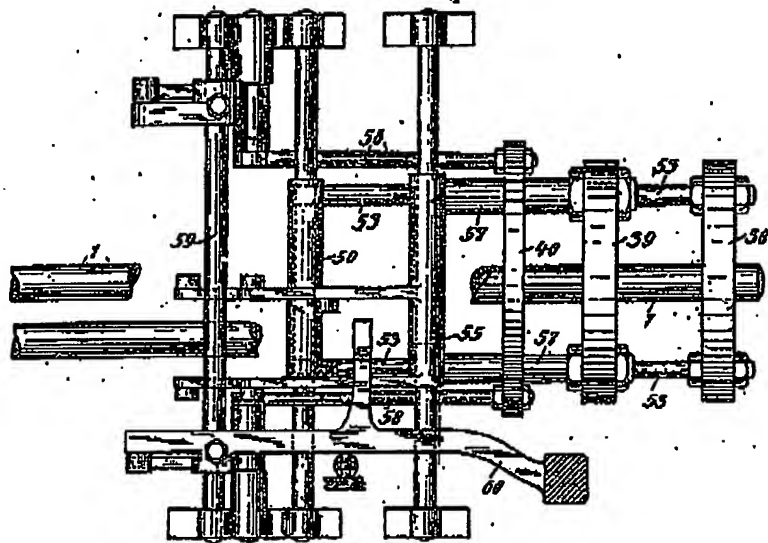


Fig. 4.

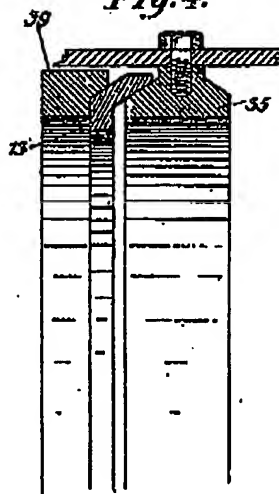
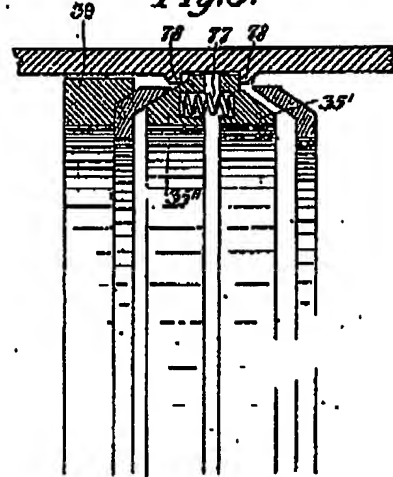


Fig. 5.





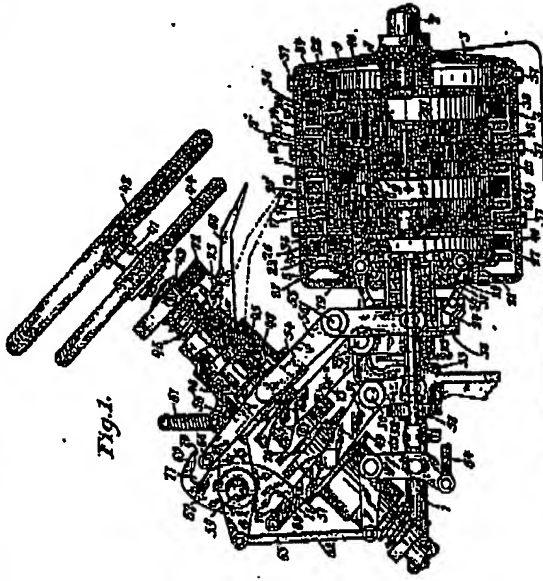


Fig. 1.

Fig. 3.

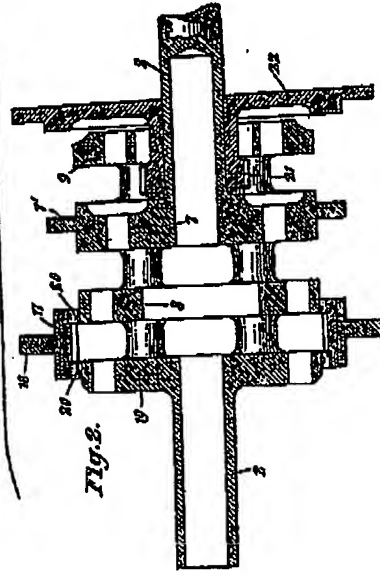
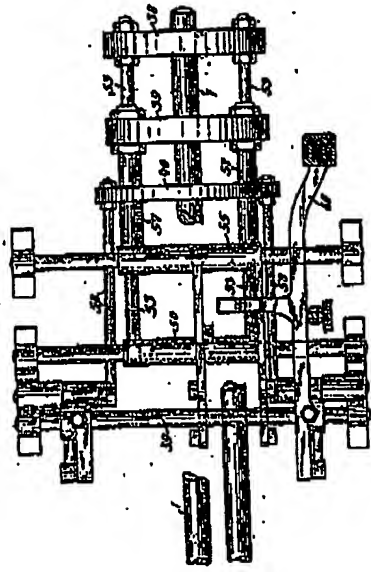


Fig. 8.

Fig. 4.

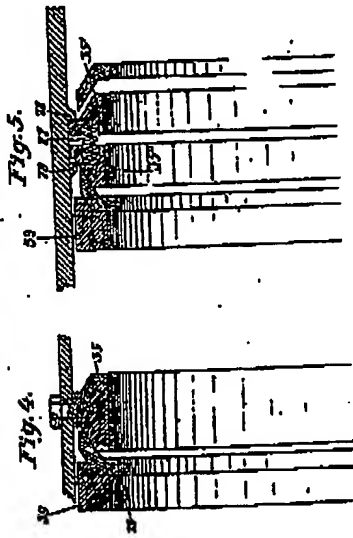
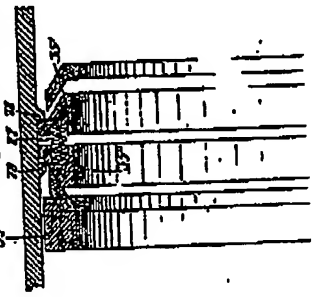
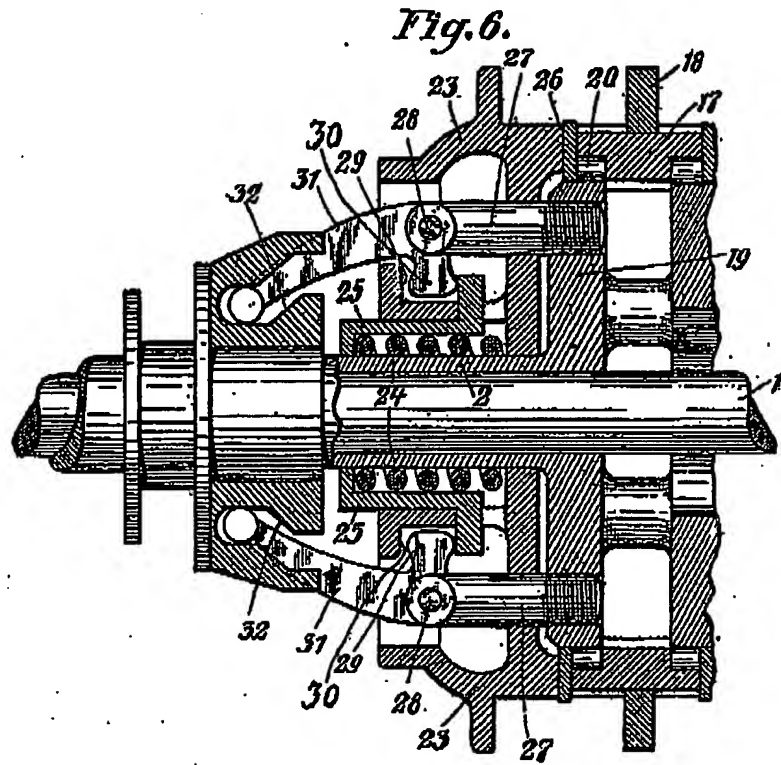


Fig. 5.



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